AE. 1. 1537
c.2

June 1999

Science 30

Grade 12 Diploma Examination

Alberta
EDUCATION

Copyright 1999, the Crown in Right of Alberta, as represented by the Minister of Education, Alberta Education, Student Evaluation Branch, 11160 Jasper Avenue, Edmonton, Alberta T5K 0L2. All rights reserved. Additional copies may be purchased from the Learning Resources Distributing Centre.

Special permission is granted to **Alberta educators only** to reproduce, for educational purposes and on a non-profit basis, parts of this examination that do **not** contain excerpted material **only after the administration of this examination**.

Excerpted material in this examination **shall not** be reproduced without the written permission of the original publisher (see credits page, where applicable).

June 1999

Science 30

Grade 12 Diploma Examination

Description

Time: 2.5 h. This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 40 multiple-choice and 12 numerical-response questions of equal value, worth 65% of the examination
- 1 short-answer question and 2 long-answer questions, worth 35% of the examination.

This examination contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

A science data booklet is provided for your reference.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

Instructions

- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- When performing calculations, use the values of the constants provided in the data booklet. Do **not** use the values programmed in your calculator.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. science
B. biology
C. physics
D. chemistry

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

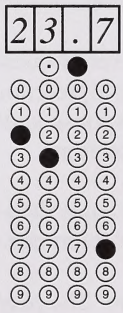
Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.
(Record your answer to three digits in the numerical-response section on the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666
= 23.7 (rounded to three digits

Record 23.7 on the answer sheet →



Correct-Order Question and Solution

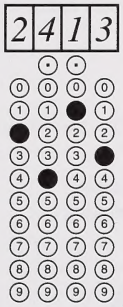
When the following subjects are arranged in alphabetical order, the order is ____, ____, ____, and ____ .

1 physics
2 biology
3 science
4 chemistry

(Record **all four digits** of your answer in the numerical-response section on the answer sheet.)

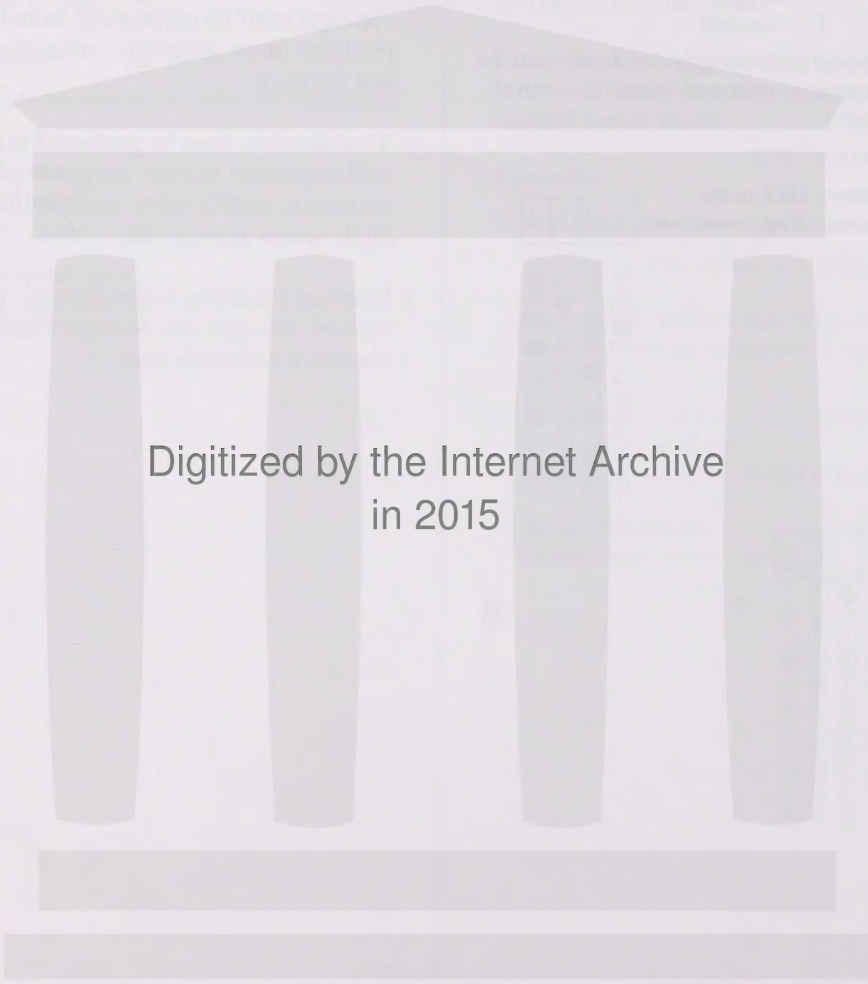
Answer: 2413

Record 2413 on the answer sheet →



Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences, correct units, and significant digits where appropriate.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and made explicit.



Digitized by the Internet Archive
in 2015

https://archive.org/details/science30grade11999albe_0

Despite improvements in medical techniques and an increased awareness by the public, heart disease is still a leading cause of death in Canada.

1. Researchers have found that members of families with a history of heart disease are at high risk of developing the disease themselves. This suggests that heart disease is directly related to

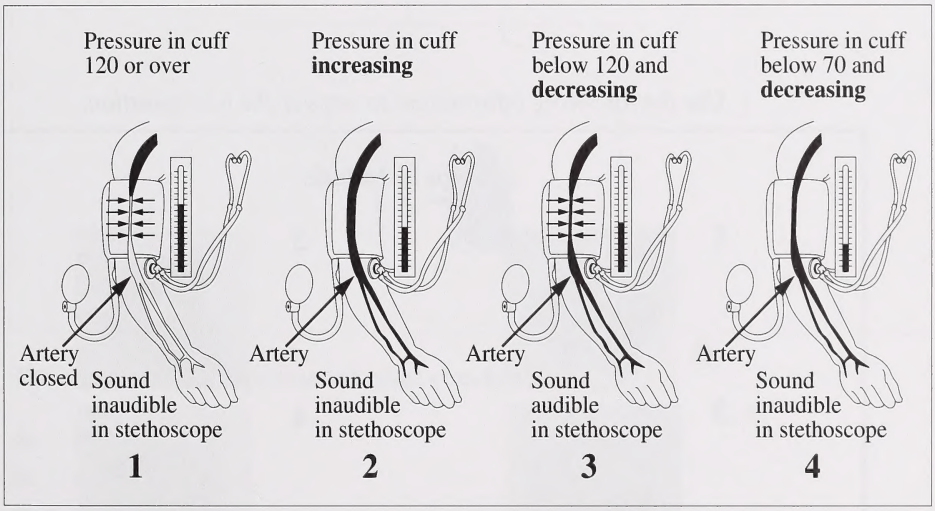
A. diet

B. heredity

C. geographic location

D. a society that does little exercise

Use the following information to answer the next question.



Numerical Response

1. Blood pressure is an indicator of a person's susceptibility to heart disease. The correct sequence of steps in measuring blood pressure with a blood pressure cuff (sphygmomanometer) is _____, _____, _____, and _____.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

Mechanisms That Influence Blood Pressure

I	Increased signals from baroreceptors in the right atrium
II	Decreased signals from baroreceptors in the right atrium
III	Stimulation by the sympathetic nervous system
IV	Stimulation by the parasympathetic nervous system
V	Dilation of blood vessels
VI	Constriction of blood vessels

2. After vigorous exercise, blood pressure increases. The mechanisms that return blood pressure to normal levels are

A. I, III, and V only

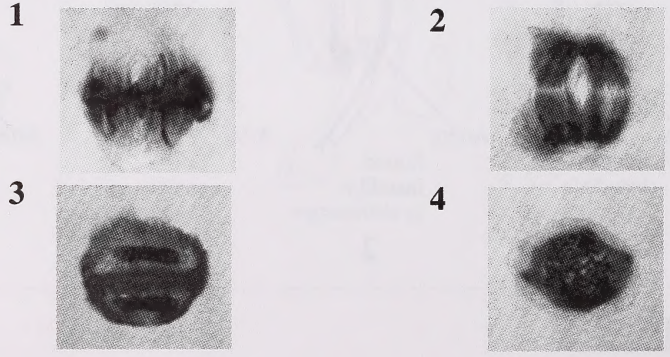
B. II, IV, and VI only

C. I, III, and VI only

D. II, IV, and V only

Use the following information to answer the next question.

Steps in Mitosis



Numerical Response

2. The sequence in which these mitotic steps occur is _____, _____, _____, and _____.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

3. In some cases of heart disease, doctors may perform a heart transplant. Identical twins are good donors and/or recipients of transplants between each other because

A. antigens from identical twins are blocked from reaching white blood cells

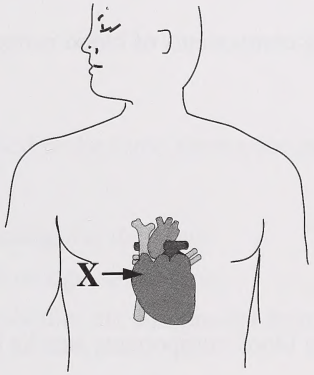
B. antibodies from identical twins are blocked from reaching white blood cells

C. the white blood cells do not identify the transplanted tissue as being foreign

D. the function of the white blood cells is suppressed when a transplant organ comes from an identical twin

Use the following information to answer the next question.

Patients suffering cardiac arrest are often revived with a defibrillator, a device that applies an electric current to heart muscles. One defibrillator electrode is placed on the chest at the position labelled **X**.



4. The electrode at **X** is positioned **most closely** to the

A. left atrium

B. right atrium

C. left ventricle

D. right ventricle

The heart pumps blood to all parts of the body. The constituents of blood perform specialized tasks to maintain the body's equilibrium.

5. Normal blood has a pH range of 7.35 to 7.45. Small changes in pH above or below this normal range are usually fatal. A normal blood sample could have a hydronium ion concentration $[H_3O^+_{(aq)}]$ of

A. 3.0×10^{-8} mol/L
B. 4.3×10^{-8} mol/L
C. 5.5×10^{-8} mol/L
D. 7.4×10^{-8} mol/L

6. Which of the following components of blood is responsible for clotting?

A. T cells
B. Platelets
C. Red blood cells
D. White blood cells

7. Which of the following blood components attacks infection-causing bacteria?

A. Platelets
B. Blood plasma
C. Red blood cells
D. White blood cells

Use the following information to answer the next question.

Immune System Responses

I	B cells produce antibodies
II	Macrophages produce antigen markers
III	Helper T cells identify the markers
IV	Antibodies attach to foreign proteins

8. If bacteria or viruses enter the bloodstream, the correct sequence of immune system responses is

A. I, II, IV, III

B. II, III, I, IV

C. II, I, III, IV

D. I, IV, II, III

---

9. When an individual is exposed to the same virus a second time, the immune system produces antibodies more

A. quickly, since T cells recognize the virus

B. quickly, since antigens recognize the virus

C. slowly, since some antibodies are still present from the first immune response to the virus

D. slowly, since most of the antibodies have been used in the first immune response to the virus

A group of scientists served as environmental advisors to a small subtropical country with diverse terrain and a Pacific Ocean coastline. The country's natural resources include forests, fish stocks, minerals, and agricultural land.

10. While working in a mountainous area, the scientists initially experienced shortness of breath, a condition that disappeared after a couple of weeks. Their bodies had responded to their new environment by increasing their

A. lung volume

B. breathing rate

C. volume of plasma

D. number of red blood cells

Numerical Response

3. The scientists spent long hours exposed to the Sun. Skin protectors were used to block harmful radiation that included radiation with a wavelength of 3.76×10^{-9} m. The frequency of this radiation is _____ $\times 10^{16}$ Hz.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

A scientist touched a spiked leaf and pulled her hand away before the sensation could have registered in her consciousness.

11. The scientist's response is an example of

A. a reflex action
B. voluntary control
C. a learned response
D. a parasympathetic response

---

12. The scientists performed a number of tests in and around an industrial area in the subtropical country. Air samples contained a high concentration of sulphur dioxide. The **most likely** source of this gas is

A. sulphur-laden hot springs
B. the clearing and burning of trees
C. the releasing of sulphates from fertilizers
D. a coal-burning, electrical-energy generating plant

Numerical Response

4. The waste water from a mining operation in the area was discharged into a holding pond, where it was subsequently neutralized. It required 30.6 mL of 0.123 mol/L $NaOH_{(aq)}$ to completely neutralize a 50.0 mL water sample from the pond. Assuming that the acid present was $HCl_{(aq)}$, the concentration of the acid in the pond was _____ $\times 10^{-2}$ mol/L.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

13. Another region in the country revealed a higher than normal accumulation of heavy metals. The **most likely** source of these heavy metals is

A. fertilizers

B. pesticides

C. pulp and paper plants

D. discarded paint and batteries

14. The scientists found that unrestricted logging practices were used in the country. They recommended that a reforestation program be immediately introduced. The practice of logging followed by reforestation is an example of

A. economic development

B. sustainable development

C. economic diversification

D. biological diversification

15. The scientists recommended using biotechnology to combat pests. By transferring genetic material, scientists can create plants with their own built-in defence mechanisms against parasites. This is an example of

A. point mutation

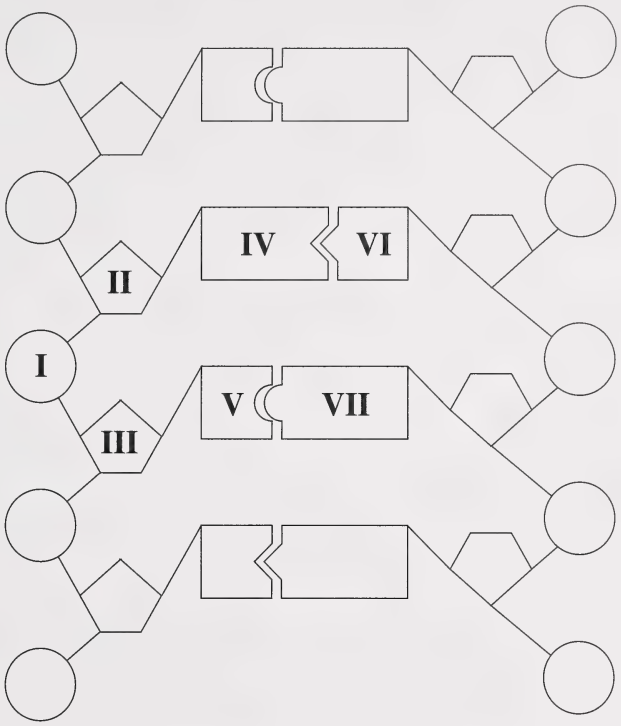
B. gene segregation

C. genetic engineering

D. chromosomal aberration

Use the following information to answer the next question.

Section of DNA Molecule



16. In the diagram above, structures that represent the base pairs responsible for the coding of gene sequences are

A. I and II

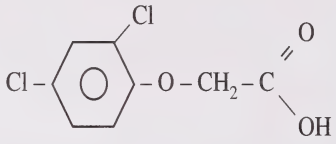
B. II and III

C. II and IV

D. V and VII

Use the following information to answer the next question.

The chemical compound 2,4-D, developed in the 1940s, was considered a major breakthrough in weed control. It killed broadleaf weeds but had no effect on narrowleaf plants. The structural formula for 2,4-D is



17. An organic functional group present in 2,4-D is the

A. ester group

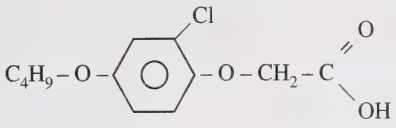
B. ketone group

C. aldehyde group

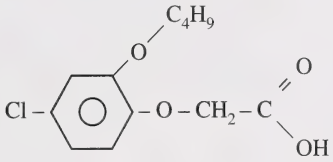
D. carboxylic acid group

18. A butyl ester is found in another pesticide. The formula for this compound is

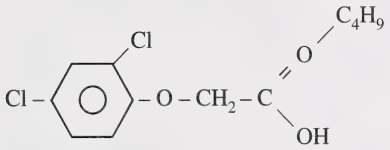
A.



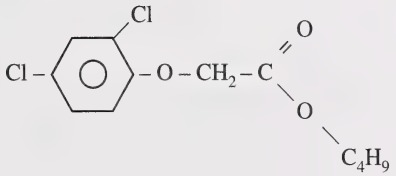
B.



C.



D.



19. To limit its negative environmental effects, a pesticide should be

A. volatile, vaporizing into the air
B. general, attacking many species
C. specific, attacking only one species
D. stable, remaining effective for long periods of time

A major portion of a country's economic wealth is derived from its fish stocks, which are in decline. A team of marine biologists was provided with a boat that allowed them to study the coastal waters.

Use the following information to answer the next question.

Forms of Energy Conversion

1 chemical → mechanical
2 electrical → electromagnetic
3 electrical → chemical
4 mechanical → electrical

Numerical Response

5. A gasoline-powered generator was used to recharge batteries on the boat. Match the form of energy conversion, numbered above, that occurs in each of the devices listed below.

Gasoline motor _____ (Record in the **first** column.)
Generator _____ (Record in the **second** column.)
A charging battery _____ (Record in the **third** column.)
Light bulb _____ (Record in the **fourth** column.)

(Record your answer in the numerical-response section on the answer sheet.)

20. The boat's generator produced steady, direct current. This type of current is characterized by

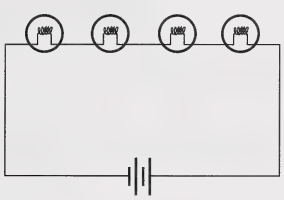
A. electrons flowing in one direction and a static magnetic field
B. electrons flowing in one direction and a changing magnetic field
C. an electron flow changing directions and a static magnetic field
D. an electron flow changing directions and a changing magnetic field

21. Acid spills from batteries can be safely neutralized with a concentrated solution of

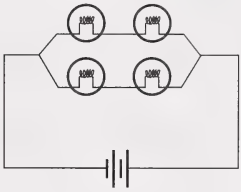
A. bleach
B. vinegar
C. table salt
D. baking soda

22. The scientists needed a light source to study their samples of small marine life. Four identical bulbs were used. The arrangement of bulbs that produced the **brightest** light was

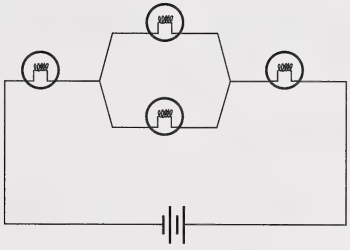
A.



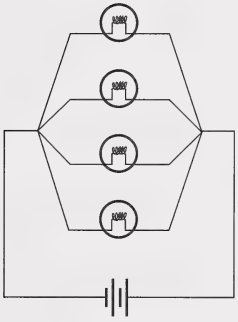
B.



C.

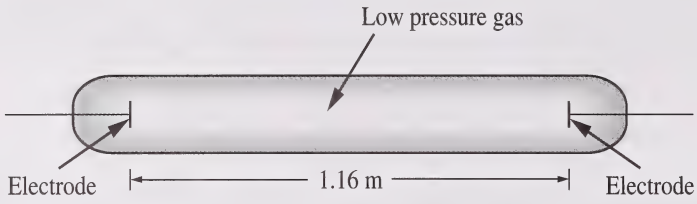


D.



Use the following information to answer the next question.

Fluorescent Tube



Numerical Response

6. A fluorescent tube was used in the tank that held their specimens. The fluorescent tube operates at 100 V. The electric field strength inside the tube is _____ V/m.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

Use the following information to answer the next two questions.

A refrigerator on the boat was rated at 300 W, 24.0 V, and was powered by two 12.0 V batteries connected in series.

Numerical Response

7. The current drawn by the refrigerator was _____ A.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

Numerical Response

8. The resistance of the motor in the refrigerator was _____ Ω.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

Numerical Response

9. Meals were prepared on a portable stove that used butane as its fuel. The equation for the combustion of butane is

$$C_4H_{10(g)} + \frac{13}{2} O_{2(g)} \rightarrow 4\, CO_{2(g)} + 5\, H_2O_{(g)}.$$

The heat of combustion for butane is –_____ $\times 10^3$ kJ/mol.

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

Use the following information to answer the next two questions.

The scientists observed that within a certain school of fish, there was a 3:1 ratio of blue fish to white fish. A number of factors could be responsible for this:

I	Both parents are homozygous for colour
II	Both parents are heterozygous for colour
III	Blue colour is dominant over white
IV	White colour is dominant over blue

23. Assuming that all the fish are from the same pair of parents, the factors that could account for this ratio of blue fish to white fish are

A. I and III

B. I and IV

C. II and III

D. II and IV

24. If a heterozygous male is crossed with a homozygous white female, what is the predicted proportion of their offspring?

A. 0% blue, 100% white

B. 25% blue, 75% white

C. 50% blue, 50% white

D. 75% blue, 25% white

---

25. In reproduction, fish **produce eggs and sperm (gametes)**. A **sperm fuses with an egg** and the resulting zygote undergoes **multiple cell divisions**. The order of the processes described above is

A. meiosis, fertilization, mitosis

B. mitosis, meiosis, fertilization

C. meiosis, disjunction, segregation

D. segregation, mutation, disjunction

A variety of strategies must be implemented by society in order to meet the world's energy requirements while minimizing the effects of energy production on the environment.

26. The **best** energy strategy that could be **immediately** implemented and that would contribute to energy savings is to

A. develop only renewable resources
B. develop more non-renewable energy sources
C. develop more efficient use of existing resources
D. increase the production of existing energy sources

27. Plants are natural solar energy collectors during the process of

A. osmosis
B. respiration
C. transpiration
D. photosynthesis

28. Solar energy can be collected by trough-like mirrors and reflected onto pipes containing a synthetic oil that can be heated to 400°C. The energy conversion sequence in this process is solar to

A. thermal

B. chemical

C. electrical

D. mechanical

Use the following information to answer the next question.

Electrical Energy Sources

I	coal
II	nuclear
III	solar
IV	wind
V	hydro

29. Which of the energy sources, given above, produce large amounts of **thermal** pollution?

A. I and II only

B. II and III only

C. I, II, and IV only

D. I, III, and V only

Use the following information to answer the next question.

Statements Relating to Tides

I	Low and high tides occur three times a day.
II	Gravitational potential energy is changed to kinetic energy.
III	The gravitational force of the Sun has less effect on tides than does the gravitational force of the Moon.
IV	The gravitational force of the Sun has a greater effect on tides than does the gravitational force of the Moon.
V	The gravitational forces of both the Sun and the Moon act together to cause spring tides.

30. Correct statements about tides are

A. I, II, and IV

B. I, III, and V

C. II, III, and V

D. III, IV, and V

---

31. Which of the following statements explains the formation of tides?

A. Earth rotates faster than the water in the oceans and the water's inertia causes it to move around the planet. This causes tides.

B. The Sun's uneven heating of Earth's surface and oceans causes wind and ocean currents. Combinations of these currents cause tides.

C. The gravity of the Moon and Sun pull on the water of the oceans and cause it to bulge. This, combined with the rotation of Earth, causes tides.

D. Magnetic and gravitational fields affect the water in the oceans, causing it to move in a large cycle synchronized with magma movement beneath Earth. This causes tides.

The CANDU nuclear reactor, which is manufactured in Canada, provides electrical power through nuclear fission.

32. The moderator used in the CANDU reactor is

A. lead
B. heavy water
C. uranium-235
D. uranium-238

Use the following information to answer the next question.

A number of fission reactions occur in the reactor core. One reaction is

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{92}_{36}\mathrm{Kr} + X + 3\,{}^{1}_{0}\mathrm{n}$$

33. The identity of species X is

A. $^{144}_{53}\mathrm{I}$

B. $^{143}_{53}\mathrm{I}$

C. $^{141}_{56}\mathrm{Ba}$

D. $^{141}_{56}\mathrm{Pr}$

Numerical Response

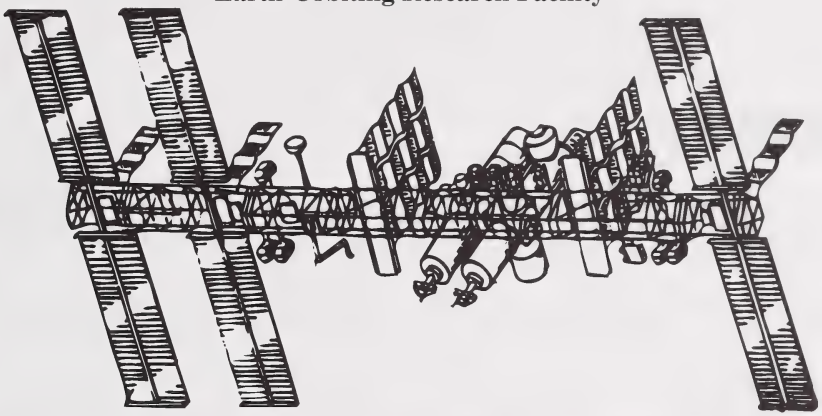
10. How much energy is produced when 1.50 kg of mass is converted to energy in a fission reaction?

Answer: _____ $\times 10^{17}$ J

(Record your **answer to three digits** in the numerical-response section on the answer sheet.)

In the near future, a space station may provide information that will add to our understanding of the universe.

Earth-Orbiting Research Facility



34. When would the space station be affected by gravity?

A. Never
B. Constantly
C. Only when near the Moon
D. Only when approaching the Sun

Use the following information to answer the next question.

Electromagnetic Radiation

1 X-rays
2 ultraviolet rays
3 visible light
4 gamma rays
5 radio waves

Numerical Response

11. Some EMR does not penetrate Earth's atmosphere significantly, so instruments designed to collect this radiation must be placed in orbit. The **three** types of radiation that are mostly blocked by Earth's atmosphere are _____, _____, and _____.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Use the following information to answer the next question.

Components of the space station would be manipulated by using a mechanical arm powered by a photovoltaic cell.

Types of Energy

I	thermal
II	electrical
III	light
IV	mechanical

35. The energy transformations needed for a photovoltaic cell to operate a mechanical arm are

A. I → II → III

B. II → III → IV

C. III → II → IV

D. III → IV → II

---

36. The absorption spectrum of the Sun provides information about its

A. mass

B. volume

C. composition

D. gravitational force

Numerical Response

12. Thermal energy for future space stations might be generated by a number of different reactions. Some of these reactions are:

1 $H_2O_{(g)} \rightarrow H_2O_{(l)}$

2 ${}^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

3 $2\,H_{2(g)} + O_{2(g)} \rightarrow 2\,H_2O_{(g)}$

These reactions, ranked in order from least to greatest amount of energy released per mole of reactant, are _____, _____, and _____.
least **greatest**

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

37. An array of solar panels may be used to provide the electrical energy requirements of the space station. A single 17.5 V solar panel will provide the energy required to operate three instruments, connected in series, with resistances of 3.95 Ω, 4.25 Ω, and 3.30 Ω, respectively. The current in the circuit will be

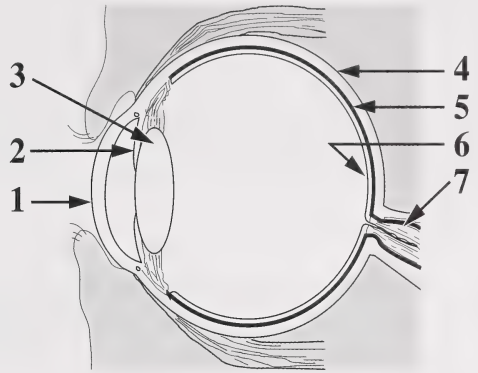
A. 0.657 A
B. 1.52 A
C. 4.57 A
D. 22.1 A

38. An astronomer aboard the space station could photograph the spectrum produced by a distant star. If a photograph showed the characteristic spectrum of hydrogen shifted toward the red end of the spectrum, it would indicate that the star is

A. increasing in velocity
B. decreasing in velocity
C. moving toward the station
D. moving away from the station

Use the following information to answer the next two questions.

Diagram of the Eye



39. The design of the camera used by the astronomer may closely resemble the design of the human eye. The structure in the eye responsible for adjusting to changing light intensity is

A. 1
B. 2
C. 3
D. 6

40. The rods and cones of the retina of the human eye are analogous to the type of film, black and white or colour, that could be used in the astronomer's camera. A colourblind person has deficiencies in

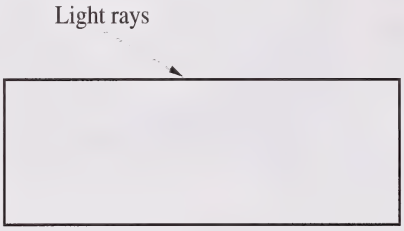
A. rods from structure 4
B. cones from structure 4
C. rods from structure 6
D. cones from structure 6

Use the following information to answer the next question.

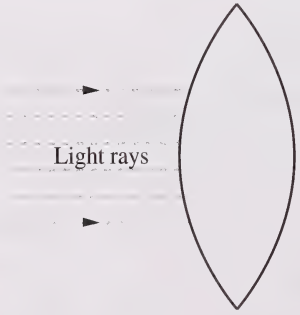
Optical instruments such as telescopes and cameras use the principles of refraction to manipulate light waves.

Short Answer – 5%

a. Complete the diagram below so that it illustrates the refraction of light as it passes from air through a rectangular block of glass and back into air.



b. Complete the diagram below so that it illustrates how a convex lens can be used to focus light.



Use the following information to answer the next question.

An industrial plant in northern Alberta emits acid-producing chemicals into the air. A lake to the east of the plant has a limestone bottom, but the pH of the lake has been lowered from an original 6.8 to 5.7. Despite the continuous addition of acid deposits, the pH of the lake remains constant at 5.7. The fish native to the lake are yellow perch and lake trout. Sport fisherman have complained that the fish population has decreased since the plant began operation. Scientists from the plant conducted an experiment to show that the plant emissions are not responsible for the decline in fish stocks.

Long Answer – 15%

1. The scientists set up a large tank containing water from the lake and maintained the pH at 5.7. Adult fish from the lake were added to the tank and fed protein pellets. The fish thrived under these conditions.

Assume that you are an independent consultant hired by the Fish and Game Association to evaluate this experiment. List additional information that you would want to have, and outline the methods that you would use to obtain this information.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Use the following information to answer the next question.

Opposing Views for the Treatment of the Environment

We have altered natural environments so drastically and so often and in so many places that the Earth and the atmosphere that surrounds it are becoming less and less protective and nurturing of living things. Humanity stands in the shadow of global catastrophe.

—Roger L. DiSilvestro

. . . environmentalist groups apparently cannot leave well enough alone. They seem to be unable to let these laws and statutory agencies work to continue the significant progress of the last two decades. Instead, they press for ever more stringent and punitive controls. They continue to push for and insist on an unachievable pristine perfection, whatever the cost. Never mind that humans never survived without altering nature.

—Dixy Lee Ray and Lou Guzzo

—from *The Environmental Crisis*

Long Answer – 15%

2. These two quotations represent opposing points of view about the use of science and technology and its effect on the environment. Explain each point of view and outline the arguments that might be used by each side. Outline your own position on this topic and use specific examples to support your position. Examples may come from your study of topics such as acid deposition, pesticides, energy production, or other environmental issues.

You have now completed the examination.
If you have time, you may wish to check your answers.

Credits

LA2 Roger L. DiSilvestro. From *The Environmental Crisis* (Greenhaven Press Inc., 1991). Reprinted under the Alberta Government Print Licence with CanCopy (Canadian Copyright Licensing Agency).

Dixy Lee Ray and Lou Guzzo. From *The Environmental Crisis* (Greenhaven Press Inc., 1991). Reprinted under the Alberta Government Print Licence with CanCopy (Canadian Copyright Licensing Agency).

No marks will be given for work done on this page.

Fold and tear along perforation.

No marks will be given for work done on this page.

Fold and tear along perforation.

Science 30
June 1999

Name

Apply Label With Student's Name

Science 30

(Last Name) (Legal First Name) Y M D

Name: **Date of Birth:** **Sex:**

Permanent Mailing Address: _____

(Apt./Street/Ave./P.O. Box) (Village/Town/City) (Postal Code)

School Code: **School:** _____ **Signature:** _____

No Name

Apply Label Without Student's Name

Science 30

For Depar

M4 M3 M2 M1

National Library of Canada
Bibliothèque nationale du Canada
3 3286 52000781 2